

What is claimed is:

1. A lithographic illumination shaping device comprising:
  - a first reflecting objective including an input end arranged to accept input light having an on-axis illumination pattern, the first reflecting objective further including a first reflective surface having a first focal point, the first reflective surface is arranged to reflect the input light through the first focal point; and
    - a second reflecting objective including an output end, the second reflecting objective further including a second reflective surface with a second focal point aligned with the first focal point, the second reflective surface arranged to receive the input light from the first reflective surface through the first and second focal points, and further arranged to reflect the input light through the output end as output light having an off-axis illumination pattern.
2. A lithographic illumination shaping device as described in claim 1, wherein the output light has a substantially off-axis, radially symmetrical illumination pattern.
3. A lithographic illumination shaping device as described in claim 1, wherein the output light has a substantially off-axis, asymmetrical illumination pattern, wherein the asymmetry is with respect to at least one of intensity and shape.

4. A lithographic illumination shaping device as described in claim 1, wherein the on-axis illumination pattern comprises a conventional illumination pattern and the off-axis illumination pattern comprises at least one of an annular illumination pattern, a concentric annular illumination pattern and a multipole illumination pattern.

5. A lithographic illumination shaping device as described in claim 1, wherein the first reflecting objective comprises a first plurality of off-axis paraboloid sections each having a reflective surface with a first focal point and the second reflecting objective comprises a second plurality of off-axis paraboloid sections each having a reflective surface with a second focal point aligned with a first focal point of one of the first plurality of off-axis paraboloid sections.

6. A lithographic illumination shaping device as described in claim 5, wherein the first reflecting objective comprises an infinite number of the off-axis paraboloid sections and the plurality of first focal points comprise a first focal ring, and wherein the second reflecting objective comprises an infinite number of the off-axis paraboloid sections and the plurality of second focal points comprise a second focal ring aligned with the first focal ring.

7. A lithographic illumination shaping device as described in claim 5, wherein the first and second reflecting objectives each comprise two paraboloid sections.

8. A lithographic illumination shaping device as described in claim 5, wherein the first and second reflecting objectives each comprise four paraboloid sections.

9. A lithographic illumination shaping device as described in claim 5, wherein the paraboloid sections of the first reflecting objective comprise the same curvature as the paraboloid sections of the second reflecting objective.

10. A lithographic illumination shaping device as described in claim 5, wherein the paraboloid sections of the first reflecting objective comprise a different curvature than the paraboloid sections of the second reflecting objective.

11. A lithographic illumination shaping device as described in claim 1, wherein the first and second reflecting objectives are centered on an optical axis of a lithography system and wherein the first and second reflecting objectives are arranged symmetrically about the optical axis.

12. A lithographic illumination shaping device as described in claim 1, wherein the first reflective surface comprises two or more first principal axes and the second reflective surface comprises two or more second principal axes, and wherein at least one of the first principal axes and at least one of the second principal axes are coaxial.

13. A lithographic illumination shaping device as described in claim 1, wherein the first reflective surface comprises a two or more first principal axes and the second reflective surface comprises two or more second principal axes, wherein the first at least one of the first principal axes is at an angle to at least one of the second principal axes.

14. A lithographic illumination shaping device as described in claim 1, wherein the first and second reflective surfaces are arranged to reflect light comprising wavelengths below 248 nanometers.

15. A lithographic illumination shaping device as described in claim 1, wherein the first and second reflective surfaces are arranged to reflect light comprising wavelengths between 8 nanometers and 193 nanometers.

16. A lithographic illumination shaping device as described in claim 1, wherein the first and second reflective surfaces are arranged to reflect light comprising a wavelength of at least one of approximately 248

nanometers, approximately 193 nanometers, approximately 157 nanometers and approximately 13 nanometers.

17. A lithographic illumination shaping device as described in claim 1, wherein the first and second reflective surfaces are arranged to reflect at least one of deep ultraviolet illumination and extreme ultraviolet illumination.

18. A lithographic illumination shaping device as described in claim 1, wherein the first and second reflective surfaces comprise at least one of fused silicon impregnated with fluorine, calcium fluoride and molybdenum.

19. A method of off-axis lithographic illumination comprising:  
receiving collimated light having a conventional illumination pattern centered on an optical axis of a lithographic exposure system;  
reflecting the collimated light in two or more directions away from the optical axis to create reflected light, wherein the collimated light is reflected symmetrically about the optical axis; and  
reflecting the reflected light to create output light having an off-axis illumination pattern symmetrical about the optical axis.

20. A method of off-axis illumination as described in claim 19, wherein reflecting the collimated light comprises reflecting the collimated light through two or more focal points of two or more paraboloid sections having reflective surfaces, and wherein reflecting the collimated light is performed by the two or more paraboloid sections.

21. A method of off-axis illumination as described in claim 19, wherein reflecting the reflected light comprises receiving the reflected light through two or more focal points of two or more paraboloid sections having reflective surfaces, and wherein reflecting the reflected light is performed by the two or more paraboloid sections.

22. A method of off-axis illumination as described in claim 19, wherein reflecting the reflected light comprises reflecting the reflected light to create output light having at least one of an off-axis dipole illumination pattern, an off-axis quadrapole illumination pattern, an off-axis annular illumination pattern, and an off-axis concentric ring illumination pattern, wherein each illumination pattern is symmetrical about the optical axis.

23. A method of off-axis illumination as described in claim 19, wherein reflecting the reflected light comprises reflecting the reflected light to at least one of: converge on the optical axis, diverge from the optical axis, or propagate parallel to the optical axis.

24. A method of off-axis illumination as described in claim 19, wherein reflecting the reflected light comprises collimating the reflected light.

25. A method of off-axis illumination as described in claim 19 further comprising:

illuminating a recticle with the output light at an angle to the optical axis to create diffracted light;  
projecting at least a first non-diffracted order and a first higher diffraction order of the diffracted light onto a substrate wafer to create a first image; and

projecting at least a second non-diffracted order and a second higher diffraction order of the diffracted light onto a substrate wafer to create a second image symmetrical to the first image.

26. A lithographic exposure system having an optical axis, the system comprising:

an illumination source arranged to produce collimated light having a conventional illumination pattern centered on the optical axis;  
a reflective illumination shaping device arranged to accept the collimated light, the reflective illumination shaping device including:

a first reflecting objective having a plurality of first paraboloid reflective surfaces each having a first focal point, the plurality of first paraboloid reflective surfaces being symmetrically arranged about the optical

axis, wherein the first reflective objective is arranged to uniformly reflect the collimated light off each first paraboloid reflective surface and through the first focal point of each first paraboloid reflective surface to create reflected light; and

a second reflecting objective having a plurality of second paraboloid reflective surfaces each having a second focal point aligned with a first focal point of a corresponding first paraboloid reflective surface, the plurality of second paraboloid reflective surfaces being symmetrically arranged about the optical axis, wherein the second reflective objective is arranged to uniformly receive the reflected light from the first reflecting objective through the second focal points and reflect the reflected light to create output light having an off-axis illumination pattern symmetrically arranged about the optical axis;

a recticle arranged to diffract the output light into at least a first and second non-diffracted order symmetrically arranged about the optical axis, and a first and second higher diffraction order symmetrically arranged about the optical axis; and

a projection system arranged to focus the first and second non-diffracted orders and the first and second higher diffraction orders onto a substrate wafer, wherein the projection system comprises at least one of a mirror and a lens.

27. A lithographic exposure system as described in claim 26, wherein the off-axis illumination pattern comprises at least one of an annular illumination pattern, a concentric annular illumination pattern and a multipole illumination pattern.

28. A lithographic exposure system as described in claim 26, wherein the second reflecting objective is arranged to symmetrically project the output light onto the recticle at an angle to the optical axis.

29. A lithographic exposure system as described in claim 26 further comprising a condenser system arranged to symmetrically redirect the output light onto the recticle at an angle to the optical axis, wherein the condenser system comprises at least one of a mirror and a lens.

30. A lithographic exposure system as described in claim 26, wherein the first and second plurality of reflective paraboloid surfaces are arranged to reflect at least one of deep ultraviolet illumination and extreme ultraviolet illumination.